

USING THE MODEL 5500 TLD READER

Purpose This Air Quality Group procedure describes the startup and operation of the Harshaw Model 5500 automatic TLD reader.

Scope This procedure applies to the use of the Harshaw Model 5500 automatic TLD reader used for photon measurements in the environmental surveillance network as part of the Direct Penetrating Radiation Monitoring Network (DPRNET) of ESH-17.

In this procedure This procedure addresses the following major topics:

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Hazard Control Plan The hazard evaluation associated with this work is documented in Attachment 1: Initial risk = **low**. Residual risk = **minimal**. Work permits required: none. First authorization review date is one year from group leader signature below; subsequent authorizations are on file in group office.

Signatures
(continued on
next page)

Prepared by: Allen Treadaway, ESH-17	Date: <u>12/05/01</u>
Work authorized by: Jean Dewart, ESH-17 Acting Group Leader	Date: <u>12/6/01</u>

01/16/02

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General information about this procedure

Signatures (continued)

Approved by: Mike McNaughton, DPR Project Leader	Date: <u>12/5/01</u>
Approved by: Terry Morgan, QA Officer	Date: <u>12/5/01</u>

Attachments

This procedure has no attachments.

History of revision

This table lists the revision history and effective dates of this procedure.

Revision	Date	Description of Changes
0	10/3/97	New document.
1	12/10/01	Updated many small details.

Who requires training to this procedure?

The following personnel require training before implementing this procedure:

- individual assigned to use TLD reader

Training method

The training method for this procedure is on-the-job training by a previously-trained individual and is documented in accordance with the procedure for training (ESH-17-024).

Prerequisites

In addition to training to this procedure, the following training is also required prior to performing this procedure:

- Electrical Safety Training (offered by the lab training group, ESH-13)

General information, continued

Definitions specific to this procedure

Reader carousel or disk: The tray used to hold the individual dosimeter elements (chips) in the reader.

TTP (time, temperature profile): The file used by the reader that contains the particular parameters used to read out a specific type of TLD element (chip).

PMT Cooler: A device sitting on top of the PMT (photo-multiplier tube), located internally to the reader. Removes excess heat and stabilizes the temperature of the PMT allowing for an extremely low dark current.

Dark current: The inherent electronic noise associated with the PMT similar to background noise.

References

The following document is referenced in this procedure:

- ESH-17-024, "Personnel Training"
-

Note

Actions specified within this procedure, unless preceded with "should" or "may," are to be considered mandatory guidance (i.e., "shall").

Checking nitrogen gas availability

Description of operation Check to see that there is sufficient nitrogen gas available for use by the TLD reader. The amount needed is dependent upon the number of dosimeters to be read. Full size nitrogen gas cylinders are used for this project and are stored outside Building 1005 under a covered retaining area. Normally about 6 cylinders are stored there at any one time. A full cylinder will show about 2,000 psig. Under normal startup and reading conditions, about 600-700 psi is used in a 6-8 hour period depending upon how long it takes the operator to setup and change dosimeters.

Equipment needed Large 16" crescent wrench -- to remove and replace the pressure regulator on the gas cylinders

Straps -- for retaining any loose gas cylinders. **Proper restraint of high pressure gas cylinders is important.**

Steps to check gas Perform the following steps to check the gas availability:

Step	Action
1	Under the covered storage area located on east side of Building 1005, check the nitrogen gas cylinder that has a regulator attached. Turn on the top valve on the cylinder. Pressure gauge should show an amount greater than 300 psi; tap the gauge to be sure it is not sticking. If lower than this, change to another cylinder.
2	Set low pressure side of regulator to about 35 psi.
3	Open small needle valve attached in-line to low pressure side.
4	Go inside TLD reader room and remove front panel cover of the reader by lifting up and pulling out at the bottom, then lifting off at the top. Place it to the side carefully so as not to break or crack the plastic. (A broken cover would allow unwanted light leaks inside.)
5	Verify that the internal pressure gauge located near the left bottom inside of the reader shows between 30-40 psi. It should not be greater than 40 psi. If it is either low or high, set the correct pressure by turning the small knurled brass knob under the pressure gauge.
6	Replace the front panel cover.

Checking nitrogen gas availability, continued

Oxygen levels The reader uses nitrogen gas which is released into the room during operation. Over a long period or if a gas line breaks, the oxygen level can be lowered. If there were a large release of the nitrogen gas into the room, the building's HVAC return air vent, located on the south wall, would provide adequate ventilation. This has been confirmed by the facility's IH representative.

Checking the PMT cooler temperature

Description of operation

For the TLD reader to function properly, both its electronics and temperature must be stabilized. This reader's photomultiplier tube (PMT) uses a solid-state cooler which draws any excess heat away from the tube. It is critical that this cooler function properly. The temperature of the cooler is displayed on the main screen, bottom left corner. If the reader has been shut down for any period of time longer than 2-3 minutes, the temperature rises to an ambient level quickly. Upon applying power again, the PMT cooler must stabilize to $9^{\circ}\text{C} \pm 2^{\circ}\text{C}$. If it does not stabilize there after 15 minutes, contact the lead technician before proceeding.

Steps to verify proper PMT cooler temp

To check the PMT cooler temperature, perform the following steps:

Step	Action
1	If the computer controlling the reader is not already on, turn it on and allow it to "boot up." Check that the printer is "on line."
2	At the "C:\>" prompt, type HARSHAW. A batch file will initiate the Harshaw/Bicron reader program shell. The first screen will only show 3 functions; select "1." By selecting "1", then "User program", the main menu will be displayed. Selection of "2" will load a demo data set, and a "3" returns to the DOS "C:\>" prompt.
3	Once the main shell has loaded and displayed, the main menu bar is located at the top of the screen. On the left side is a vertical box showing the "PMT Cooler" temperature. This should read $9^{\circ}\text{C} \pm 2^{\circ}\text{C}$. NOTE: This temperature is critical to proper operation of the reader; do not proceed if it does not stabilize to this temperature after a minimum of 15 minutes. Normally, with proper gas flow, the time for stabilization will be about 5-10 minutes.

Loading startup disk and opening files

Description of process Upon loading a disk with chips that are reserved only for this process and opening the required files, the reader will then be in a state where it can be brought to its normal operating temperature. This temperature is slightly above the normal room ambient, usually around 24 - 26° C. When a disk is initially loaded into the reader, it is usually less than ambient temperature. The first few readings taken are usually much higher than if the disk and reader had not been warmed to room temperature. These higher-than-normal readings are then suspect. Since this reader uses hot nitrogen gas, by running about 25 chips prior to the routine reading, the reader is warmed sufficiently to prevent any initial abnormally high reading.

Steps to load disk and open files Perform the following steps to load the startup disk and open the required files needed to bring the reader to an operating temperature.

Step	Action
1	Load 25 chips from the “startup” petri dish located on the bench top into any unused disk. Load these in positions 11-35 and leave the first 10 positions empty; these are for the test light only.
2	Open the tray by pushing the front panel button; load the disk onto the drawer tray. Press the button again to slide disk into the reader. A whirring sound will indicate that the disk is spinning and locating its starting point.

Steps continued on next page.

Loading startup disk and opening files, continued

Step	Action
3	<p>From the top menu bar on the TLD reader shell program, open the following files under the “FILE - OPEN” function:</p> <ul style="list-style-type: none">a.) Response file- (has a “*.TLD” extension). Select from the “TLDATA” sub-directory a file with a name similar to “stup07.tld”. There are several located here, most using a naming convention of “stup” followed by additional characters which reference the month/year. If you wish to name a new one, place the cursor in the name field at the top of the box. You are limited by DOS to no more than 8 characters, followed by the extension “*.TLD” All response files must have the “*.TLD” extension.b.) Acquisition Setup file- use the current file located in the directory: C:\ \tldata\2001. These files will have a “*.par” (parameter) extension. One file in this directory is called “stup.par”. Highlight it and press “Enter”.c.) TTP file- Select the file called “startup.ttp” located in the same directory. Highlight and press “Enter” to open it.d.) Dosimeter file- this is a text file with several columns corresponding to the dosimeter ID and disk position for each chip, located in the same directory as in step b. One file is labeled “chipset1.txt.” Highlight and press “Enter”.e.) Check which files are open by selecting "File" from the menu bar, then click on "open" and then "current list".
4	<p>Using the main menu bar, highlight the “Read” function, then the “Go.” The printer will scroll one page up and the header information will be printed. The read cycle will begin.</p>
5	<p>At the completion of the reading of the “startup” chips, remove the disk and unload the chips, returning them to the “startup” petri dish. You are now ready to verify that the reader is ready for normal operations. From the menu bar, select "Parameters" and then "Acquisition". Change the "PMT noise interval" and "Test light interval" from 1 to 25 and click on "Save".</p>

Verifying PMT noise, test light, and high voltage stabilities

Description of process Two tests that evaluate the Model 5500's accuracy and efficiency are the PMT noise readings (also known as the PMT's dark current) and the test light readings. Both of these tests are taken at regular intervals during routine operation (once at beginning and again at the end of a disk). They can also be taken at more frequent intervals, set at the discretion of the operator in the "Acquisition" file setup. For the purpose of starting up the reader, it is necessary to verify the stability of these readings before any further processing of dosimeters.

Steps to verify the PMT noise and test light readings To verify the PMT noise and test light readings, perform the following steps:

Step	Action
1	During the reading of the "startup" tray in the previous chapter, the TLD reader takes three readings and prints the results as: a) PMT Noise, b) Test Light, and c) a blankTLD reading. On the printout (using a hand calculator), average the 10 readings from positions 1-10 for the PMT noise and for the test light.
2	To verify the PMT dark current stability, the criterion for a "PASS" is a value of less than 0.2 nC . Note on the printout whether the criterion is met. NOTE: The range for the readings is normally 0.06 nC to 0.62 nC. The reader will automatically stop if outside this range.
3	To verify the Test Light reading (used to check the continuity and reproducibility of the photonics subsystems), the average of the 10 readings should be 200 nC $\pm 10\%$. Determine the relative standard deviation (percent coefficient of variation). The test criterion for a "PASS" is a relative std. deviation of less than 1%. NOTE: The range for the readings is normally 170 - 220 nC.
4	At bottom left of the display, above the high voltage value, verify that the GAIN is set to HIGH by a visual check. Verify that the PMT high voltage is 892 VDC (± 2 VDC) before and after the readings of the chips on the startup disk. NOTE: The gain setting should never be changed to LOW, but could be done accidentally by simply highlighting it.

Steps continued on next page.

Verifying PMT noise, test light, and high voltage stabilities, continued

Step	Action
5	There are no calculations necessary for the chips that are in positions 11 through 35 on the tray. These are only used to bring the reader up to operating temperature. At the end of the 25 chips, the reader should be at a temperature near 40°C where normal analyses can begin. This is displayed above the PMT cooler temperature on the left side.
6	If any of the values above are outside normal acceptance criteria, contact the lead technician before proceeding.

Loading chipset text files

Description of operation Before a read cycle can begin, the reader must know which dosimeter is loaded and the position on the tray it occupies. This is accomplished through the older version of the TLDNET database. Within this database resides an “Issue/Pickup” table, a “Chipset Input” table, and a macro called “Export Chipset”, to load the information generated from tables onto a 3.5” floppy for later download to the Model 5500 TLD reader computer.

Steps to generate a chipset file To generate a proper chipset text file used by the TLD reader when the “DOSIMETER” parameter function is accessed, perform the following steps:

Step	Action
1	Issue a set of dosimeters in a version of the older TLDNET database.
2	For a set of 10 dosimeters, enter their ID #'s into the “Chipset Input” table in the database.
3	Run the macro “Export Chipset.” In the design mode, click on "transfer text" to change the name for the file to be copied to the 3.5” floppy to one appropriate for the set of dosimeters you are reading. For example, if you are reading from the MAIN field set, name the file for the first 10 dosimeters on first tray, “MAIN_1.TXT”. The second set of 10 dosimeters would then be named “MAIN_2.TXT”, etc. Save the changes and click on "run" to run the macro. Repeat this step until all of the dosimeters have been entered into a "Dosimeter" file for use by the reader.
4	At the “C:/" prompt on the reader computer, using the DOS copy command, copy the files named above into the appropriate sub-directory. Example: if the files above were named for the MAIN field set, then the files would be copied into the sub-directory called MAIN.

Loading disks for normal reading of dosimeters

Description of operation Prior to beginning the reading of the dosimeter chips, the disks holding the chips must be loaded. This involves removing the 5 individual chips from each dosimeter and placing them in slots in the carrier disk.

Equipment needed Collect the following equipment located in Building 1005, Room 2, from either the east wall counter top or in the drawers below the reader:

- six disks to hold the 1/8" chips
- one small glass petri dish to hold the chips from each "acorn" dosimeter
- one small pair Teflon coated tweezers to remove any stuck plastic inserts
- one small, bench-top electrical vacuum pick for moving the chips from the petri dish to the disk
- dosimeters to be read

Load the disk Carefully transfer the TLD chips into the depressions in the disks for the 5500 TLD reader. If the number of dosimeters exceeds the number of disks, repeat this step after the read cycle and unloading steps.

Steps to insert a disk To insert a disk into the reader, perform the following steps:

Step	Action
1	Open disk drawer by pressing front panel button.
2	After trays slides out, move disk from bench top to the reader tray. TAKE CARE to not accidentally jar or cause the disk to be moved such that the loose individual chips on the disk become dislodged from their respective slots. The mixing of chips will invalidate those dosimeters.
3	Close disk drawer using front panel button. A spinning sound will be heard indicating that the disk has been set to the correct place.

Starting the read cycle

Description of operation This chapter describes how to read a group of dosimeters and includes some preliminary settings of files. It is not meant to address all possible operations, rather only normal, routine operations while reading dosimeters from the ESH-17 Direct Penetrating Radiation Monitoring Network.

Several files need to be opened before any readings can be taken. Once they are opened, and a read cycle has been initiated, a glow curve will be displayed on the computer screen, along with the results on the right side. Often the glow curve will be re-plotted to full scale if there are differences between readings of different intensities. When the reader heater temperature drops to around 80 °C, the reader will move to the next chip and start the data acquisition again. When all chips have been read on a disk, the message “Read sequence is complete” will appear. You can then remove that disk, insert another and begin the read cycle again. Another chipset file will need to be opened, but under normal circumstances, that will be the only file requiring a change.

Steps to read a disk Proceed with the following steps to read one disk of chips.

Step	Action
1	Ensure that the reader has been warmed up according to the steps in the first chapter.
2	Open a “Response” file. All TL readings (raw data) are stored in this file. Select OPEN from File pull-down menu, then select “Response.” A file selection dialog box will be displayed along with any previously read files in sub-directories. Select the sub-directory needed for the particular group of dosimeters to be read, i.e., for the year 2001, quarter 3, select TLDATA\2001\QTR3\01Q03FLD.TLD. If this is a new read and you wish to create a new response file, then at the top of the file box (in the Filename Field, which will display “*.TLD”), you can input a new file name (limited to 8 characters or less). The system will automatically add the “.TLD” extension. Select the “SAVE” button and a message will appear indicating “New Response File Opened.” Select “ENTER” to clear. If you are using a previously created file and wish to append data to it, then by highlighting that file and pressing “ENTER” the last record in that file will displayed, and all current readings will be saved there.

Steps continued on next page.

Starting the read cycle, continued

Step	Action
3	Select an "Acquisition Setup" file. The file "TLDSHELL.PAR" under the first subdirectory is the default file used for all normal readings of the field set. There is only the one file in this subdirectory; highlight it and press "ENTER".
4	Select a "TTP" file. Again, there is only one file, the default file "TLDSHELL.TTP" in the first subdirectory. As above, highlight it and press "ENTER".
5	Select a "Dosimeter" chipset file (loaded earlier as described in previous chapter) that corresponds to the disk in the reader. Highlight it and press "ENTER."
6	When all files have been opened, highlight the "READ" function on main menu bar. Under this are two sub-functions: "GO" and "CONTINUE." Highlight "GO" and press "ENTER" key. [The "CONTINUE" function resumes if previously halted by pressing the "ESC" key.]
7	After starting by pressing "GO", the printer will print a header and the read cycle will begin.
8	At the end of the read cycle (usually 45 minutes), "Read sequence is complete" is displayed. Remove disk and insert next disk as described previously in "Steps to insert a disk."
9	Continue with step 5 to open the next chipset file. While next disk is reading, prepare additional disks with chips to be read.
10	After all disks have been read, go outside to nitrogen bottles and first lower regulator to 20 psi; then turn off nitrogen gas at the valve on top of cylinder.
11	Store empty disks in drawer on right side of bench. Turn off video display to prevent screen "burn in." Store tweezers and petri dishes in drawer under bench top. Turn off lights.

Exporting the data

Description of operation

After the read cycle is completed, the data must be exported out of the TLD Shell for use in the TLDNET database. This is accomplished thru the use of a utility program called "EXPORT". This function resides under the "FILE" menu selection and produces an ASCII file output. The response file that contains the raw data is converted to the ASCII file with the same name but with an extension of "*.ASC" instead of "*.TLD." The specified content of the exported file is determined by the configuration file named "TLDEXPT.CFG." See the operator's manual for more details on this file. It should not be changed without consent or direction from the lead operator, as any changes will output different information than that required by the database.

Steps to export data from reader

To export data from reader, perform the following steps:

Step	Action
1	Select "Response" file to be exported.
2	Under the "FILE" function on main menu, select (highlight) "EXPORT." Press "ENTER."
3	Display will indicate when completed by showing message " <i>n</i> records successfully exported." Highlight the "OK" to continue. If there had already been a file with the same name and an EXPORT had been attempted, a message indicating "File Exists—Do you wish to Append, Overwrite, or Cancel?" Select the appropriate response you wish. Normally files will not be overwritten—only with lead operator's permission. Appending is OK, but if the desire is to create new file, then the existing response file's name must be changed using DOS naming conventions. Contact the lead operator.
4	If additional files need exporting, repeat steps 1 to 4.
5	Exit the TLD Shell program from FILE function on main menu bar.
6	Go to sub-directory where the exported file was saved -- the same directory where the response file resided. Copy the file using DOS "Copy" command to a Zip drive, to the network drive, or to some other storage medium.
7	Take the disk to a networked computer and copy the files into the sub-directory where the TLDNET database resides.
8	Back up the computer data by copying onto the group network drive. [This drive is backed up daily and weekly copies are kept indefinitely.]

Records resulting from this procedure

Records

The following records are generated as a result of this procedure will be filed in accordance with the procedure for notebooks (ESH-17-011):

- Printout of the startup readings
- Printout of all readings of field data

HAZARD CONTROL PLAN

1. The work to be performed is described in this procedure.

“Using the Model 5500 TLD Reader”

2. Describe potential hazards associated with the work (use continuation page if needed).

Potential burns from touching chips too soon after analysis process

Low oxygen levels from N gas in room.

3. For each hazard, list the likelihood and severity, and the resulting initial risk level (before any work controls are applied, as determined according to LIR300-00-01.0, section 7.2)

Potential burns from picking up chips too soon after analysis process -- Negligible / Improbable = Minimal

Low oxygen levels from N gas in room -- Critical / Improbable = Low

NOTE (9/15/00): cylinders are no longer moved by group personnel, only gas plant employees.

Overall initial risk: ☐ Minimal ☒ Low ☐ Medium ☐ High

4. Applicable Laboratory, facility, or activity operational requirements directly related to the work:

☐ None ☒ List:

Work Permits required? ☒ No ☐ List:

AR 14-1 “Pressure Systems Including Compressed Gas Systems”

HAZARD CONTROL PLAN, continued

5. Describe how the hazards listed above will be mitigated (e.g., safety equipment, administrative controls, etc.):

Burns -- since the burns received have been minor, no mitigation has been required (since the first occurrence, it hasn't been repeated). Use common sense -- don't bump carousel to dislodge chips. Moving gas cylinders causing strains -- Gas cylinders have been relocated and a manifold installed for using 3 cylinders at once to prevent having any personnel move cylinders frequently. Cylinders should be moved by Gas Facility personnel when possible.

Moving gas cylinders causing it to fall, breaking valve off -- movement of gas cylinders allowed only with caps properly attached and should be moved by Gas Facility personnel when possible.

Low oxygen levels from N gas in room: There are three tanks of N gas outside the reader trailer that are manifolded together. An ESH-4 industrial hygienist evaluated the hazards of a gas leak into the trailer and determined that the 1/4" stainless steel piping (from the manifold to the TLD reader) could not release gas fast enough to cause an oxygen-deficient atmosphere. A pressure relief valve set at 40 psi (the max the instrument can take) is installed outside at the manifold.

6. Knowledge, skills, abilities, and training necessary to safely perform this work (check one or both):



Group-level orientation (per ESH-17-032) and training to this procedure.



Other → See training prerequisites on procedure page 3. Any additional describe here:

7. Any wastes and/or residual materials? (check one) ☒ None ☐ List:

8. Considering the administrative and engineering controls to be used, the *residual* risk level (as determined according to LIR300-00-01.0, section 7.3.3) is (check one):



Minimal



Low



Medium (requires approval by Division Director)

9. Emergency actions to take in event of control failures or abnormal operation (check one):



None



List:

For strains and any other injuries from movement of cylinders, provide first aid and then see that injured person is taken to ESH-2 or hospital.

Signature of preparer of this HCP: This HCP was prepared by a knowledgeable individual and reviewed in accordance with requirements in LIR 300-00-01 and LIR 300-00-02.

Preparer(s) signature(s)

Name(s) (print)

/Position

Date

Signature by group leader on procedure title page signifies authorization to perform work for personnel properly trained to this procedure. This authorization will be renewed annually and documented in ESH-17 records. Controlled copies are considered authorized. Work will be performed to controlled copies only. This plan and procedure will be revised according to ESH-17-022 and distributed according to ESH-17-030.

